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ABSTRACT

A glossary of 50 astronimical terms is presented. Among terms included are: Asteroid; Big Bang; Binary Star; Black Hole; Comet; Constellation; Eclipse; Equinox; Galaxy; Globular Cluster; Local Group; Magellanic Clouds; Nebula; Neutron Star; Nova; Parsec; Quasar; Radio Astronomy; Red Giant; Red Shift; S.E.T.I.; Solstice; Supernova; and White Dwarf. (YP)

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A Brief Glossary of Commonly Used Astronomical Terms

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by *Sherwood Harrington*

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Asteroid: Any of the thousands of small rocky objects that orbit around the Sun, most of them between the orbits of Mars and Jupiter (although some pass closer to the Sun than Earth does and others have orbits that take them well beyond Jupiter.) The largest asteroid is one called Ceres; it's about as wide as the state of Texas.

Astronomical Unit: A unit of distance equal to the average spacing between the Earth and the Sun. Usually abbreviated "A.U.", it is equal to about 150 million kilometers (93 million miles), and is a distance that light takes about eight minutes to cover. It is a handy size to use for expressing distances in the Solar System. (For example, the diameter of the orbit of the most distant planet, Pluto, is about 80 A.U.)

Astrophysics: The part of astronomy that deals with the physical processes that regulate activity in the universe. For example, the study of thermonuclear fusion reactions that power stars is part of astrophysics, as is analysis of the interactions of light and matter in stars and nebulae.

Big Bang: The primeval explosion which most astronomers think gave rise to the Universe as we see it today, in which clusters of galaxies are moving apart from one another. By "running the film backward" — projecting the galaxies' motions backward in time — astronomers calculate that the Big Bang happened about 15 to 20 billion years ago.

Binary Star: A system of two stars, orbiting around one another. Binary (and triple and even higher multiples) stars are very common; astronomers estimate that about half of all stars are members of multiple-star systems. The nearest "star" to our solar system, Alpha Centauri, is actually our nearest example of a multiple star system — it consists of three stars — two very similar to our Sun and one dim, small, red star — orbiting around one another.

Black Hole: An object whose gravitational pull is so strong that — within a certain distance of it — nothing can escape, not even light. Black holes are thought to result from the collapse of certain very massive stars at the ends of their lives, but other kinds have been postulated as well: "mini black holes," for example, which might have been formed in turbulance shortly after the big bang. "Supermassive black holes" — with masses millions of times the Sun's — may exist in the cores of large galaxies.

Comet: A small chunk of ice, dust, and rocky material (only a few miles across) which, when it comes close enough to the Sun, can develop a tenuous "tail." Tails of comets are made of gas and dust that have been driven off the comet's surface by the Sun's energy and they always point away from the Sun (no matter what direction the comet is moving). Comets spend most of their time very far from the Sun, and are active only for a short period (a few months at most) as they move quickly around the Sun on their elongated orbits.

Constellation: A pattern of stars on the sky, named for a person, animal, or object (usually from mythology.) Astronomers use constellations to designate directions in space; for example the Great Galaxy "in Andromeda" lies in the direction from us marked by the pattern of stars we call Andromeda (the Princess of Ethiopia in Greek mythology). Just as patterns we see in the clouds are not permanent, neither are the star-patterns of constellations, since the stars move (albeit very slowly on the timescale of a human lifetime). The constellations of 100,000 years ago were quite different from today's. Astronomers now divide the sky into 88 sectors, each of which is named after the traditional constellation in that sector.

This glossary is one of a series of educational materials produced by the nonprofit Astronomical Society of the Pacific. Founded in 1889, the international Society works to support astronomical research and to enhance the public understanding of astronomy. Among its many activities, the Society sponsors a magazine explaining astronomical developments in everyday language, a newsletter on teaching astronomy in grades 3 - 12, and a summer meeting bringing together astronomers, educators, hobbyists, and astronomy enthusiasts of all ages. To receive membership information and an illustrated catalog of slides, posters, videos, observing aids, and computer software, write to: Information requests, Dept. G., Astronomical Society of the Pacific, 390 Ashton Ave., San Francisco, CA 94112, U.S.A.

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Cosmology: The branch of Astronomy that deals with the origin, large-scale properties, and the evolution of the observable universe.

Crescent Moon: See "Phases of the Moon".

Eclipse: The blocking of all or part of the light from one object by another. For example, a "Lunar Eclipse" occurs when the Earth's shadow falls on the Moon, preventing sunlight from illuminating all of its surface. A "Solar Eclipse" occurs when the Moon passes directly between us and the Sun, blocking part or all of its light from reaching us. Lunar eclipses can occur only when the Moon is on the opposite side of the Earth from the Sun (at Full Moon), while Solar Eclipses can happen only at New Moon. (See "Phases of the Moon.")

Equinox: Either of the two instants during the year when the Sun is directly over the EArth's equator. In the Spring, the Vernal Equinox occurs around March 21st, and in the Fall the Autumnal Equinox happens around September 21st (although the specific dates vary slightly from year to year.) At the time of the equinoxes, the length of day and night are very nearly equal all over the world. Spring and Fall officially begin at the instants of the Vernal and Autumnal Equinoxes, respectively.

Galaxy: A large assemblage of stars (and sometimes interstellar gas and dust), typically containing millions to hundreds of billions of member stars. A galaxy is held together by the gravitational attraction of all its member stars (and other material) on one another. Most galaxies are either of a flattened, spiral form or a fatter ellipsoidal shape without a spiral pattern. The "Milky Way Galaxy" of which our Sun is a part is a spiral galaxy with a disk about 100,000 light years across containing roughly 400 billion stars. Our Sun is in the disk, about 2/3 of the way out from the center, and orbits around the center for the Milky way taking about 200 million years to go around once.

Globular Cluster: A large congregation of stars (containing hundreds of thousands to about a million stars) which is spherical in form. About 150 globular clusters are members of our Milky Way galaxy, distributed in a round halo around the Galaxy's disk. Globular clusters, which can also be detected in other galaxies, are made up of very old stars (twice the age of the Sun or more).

Light Year: The distance light travels in one year in a vacuum. Light travels at a speed of about 300,000 kilometers per second (186,000 miles per second) in a vacuum. A light year is about nine and a half trillion kilometers (6 trillion miles) long.

Local Group: The relatively small cluster of galaxies of which our Milky Way is a part. It is known to contain about two dozen member galaxies, but most of those are "dwarf" galaxies, considerably smaller than our own. There are only two large galaxies in the local group: the Milky Way and the Andromeda Galaxy (about two million light years away from us in the direction of the sky marked by the constellation Andromeda.) The Local Group is about three million light years across, and is itself part of a "supercluster" of clusters of galaxies which is centered on a huge aggregate called "The Virgo Cluster."

Magnitude: A way of expressing the brightnesses of astronomical objects inherited from the Greeks. In the magnitude system, a *lower* number indicates a *brighter* object (for example, a 1st magnitude star is brighter than a 3rd magnitude star.) Each step in magnitude corresponds to a brightnesss difference of a factor of about 2.5. Stars of the 6th magnitude are the faintest the unaided human eye can see.

Magellanic Clouds: The two closest galaxies to us which are satellites of our own Milky Way. They are each irregular in form and relatively small (only about 1/5th as broad as the Milky Way's disk.) They are roughly a hundred thousand light years away from our Galaxy in a direction such that they can be seen easily only from Earth's southern hemisphere. The first Europeans to record their existence were Ferdinand Magellan's crew in the early 1500's; to them, the two galaxies looked like small clouds separated from the Milky Way.

Meteor: A bit of solid debris from space, burning up in Earth's atmosphere due to friction with the air. (The luminous streaks they trace across the sky are commonly called "shooting stars," although they have nothing to do with stars!) Before entering Earth's atmosphere (with a typical speed of about 25,000 mph) the body is called a "meteoroid." If any of the object survives its fiery passage down through the air, then those parts which hit the ground are called "meteorites."

Milky Way: A faint band of hazy light that can be seen from clear, dark locations and which stretches all the way around the sky. When looked at using binoculars or a small telescope, it is seen to be composed of vast numbers of individual, faint stars. It is actually the disk of our own Galaxy — seen from our perspective (within the disk), the flat lens-shape of the Galaxy appears to surround us. Astronomers often use the term "Milky Way" to refer to our entire Galaxy, rather than to just its appearance in our sky. (See "Galaxy.")

Moon: The Earth's large natural satellite. (While this term is sometimes used to denote any object orbiting around a planet, many astronomers prefer that the term "satellite" be used instead for the generic case.)

Nebula: A cloud of gas and/or dust in interstellar space. (The word "nebula" in Latin means "cloud"; its plural is "nebulae.") Nebulae can make themselves apparent by glowing (as "emission nebulae"), by scattering light from stars within them (as "reflection nebulae"), or by blocking light from things behind them (as "obscuration nebulae").

Neutron Star: A crushed remnant left over when a very massive star explodes. Made almost entirely of neutrons (subatomic particles with no electric charge), these stellar corpses pack about twice as much mass as there is in the Sun into a sphere only about ten kilometers across. A teaspoonful of their material would weigh more than all the automobiles in the US put together. Some neutron stars are known to spin very rapidly, at least at the beginning, and can be detected as "pulsars"; rapidly flashing sources of radio radiation or visible light. The pulses are produced by the spinning of the neutron star, much like a spinning lighthouse beacon appears to flash on and off.

Nova: A star that abruptly and temporarily increases its brightness by a factor of hundreds of thousands. Unlike supernovae (much more violent explosions which destroy the stars that produce them), stars that "go nova" can do so more than once. Novae are thought to occur in binary stars in which one member is a compressed dwarf star (such as a white dwarf or a neutron star) orbiting close to a much larger star. According to this theory, material from the larger star's outer layers accumulates on the dwarf's surface, becoming ever hotter and more compressed by the dwarf's strong gravity, until the "stolen" material explodes. (See "supernovae," "binary star," "white dwarf," and "neutron star.")

Observatory: A place where telescopes are kept. Major astronomical observatories are now placed primarily on remote mountain tops to escape the bright light of cities and to take advantage of the steady and clear viewing that high altitudes generally afford. (Most "radio observatories" need not be located at high altitudes, though, since most of the radio waves that can be studied from Earth make it all the way through our atmosphere) easily.) (See "telescope," "radio astronomy.")

Orbit: The path of one body around another (such as the Moon around the Earth) or around the center of gravity of a number of objects (such as the Sun's 200-million-year path around the center of the Galaxy.)

Parsec: A unit of distance equal to about 3.26 light years (or, more precisely, equal to 206,265 Astronomical Units). Technically, a parsec is defined to be the distance from which the Earth and Sun would appear to be separated from one another by one second of arc (about the size a dime would appear to be if seen from a distance of two miles.)

Phases of the Moon: The changing appearance of the Moon as it orbits around the Earth. At "New Moon," the Moon is on the same side of the Earth as the Sun is, and we see only the part of the Moon which is in shadow (another term for New Moon is the "dark of the Moon"). A quarter of an orbit later (about a week after New Moon), we see the Moon illuminated by sunlight from the side. Thus one-half of the disk of the Moon which faces us is in sunlight — the right side as seen from Earth's northern hemisphere: this phase is called "First Quarter." About two weeks after New Moon, our satellite has traveled around to the other side of its orbit, and the side facing us also faces the Sun and is fully illuminated as we see it; that phase is called "Full Moon." Three-quarters of a lunar orbit after New Moon, at "Last Quarter," the Moon is again illuminated from the side (the left side as seen from the northern hemisphere). About a week after that, the Moon is New again, and the cycle starts over. Between First Quarter and Last Quarter, when more than half of the side of the Moon facing us in sunlight, the Moon is said to be "Gibbous." From Last Quarter to First Quarter, when more than half of the side of the Moon facing us is in shadow, the Moon is said to be a "Crescent."

Planet: A major object which orbits around a star. In our solar system, there are nine such objects which are traditionally called "planets": Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto. (There are no "official" specifications for how big an object must be to be called a planet rather than, for example, an "asteroid.") While no individual planet has ever been seen orbiting around another star, we wouldn't expect to see them, given the limits of current technology. It is suspected, though, that planets are common companions of stars.

Planetarium: A domed theater in which a special device in the center of the room projects a simulation of the nighttime sky onto a dome above the audience. Planetaria generally can show how the nighttime sky looks from anywhere on the Earth's surface at any time (for thousands of years into the past and future).

Pulsar: See "Neutron Star."

Quasar: One of a class of very distant (typically billions of light years away), extremely bright, and very small objects. The term "quasar" means "quasi-star" — that is, something that looks like a star but can't actually *be* a star. A typical quasar produces more light each second than an entire galaxy of stars does, and it does so from a region of space which is perhaps as small as our Solar System. Precisely how they produce their prodigious amounts of energy is not known, but astronomers suspect that their brilliance may be connected with the violent effects of very massive black holes at the centers of distant, dim galaxies on material right around them. (See "Black Hole.")

Radio Astronomy: The study of radio waves from objects in the universe. Radio and visible-light waves are the only kind of light-like radiation which can reach the ground easily from space. Partly because of this, radio astronomy became the first non-visible branch of astronomy, with large radio telescopes (instruments which can gather and focus radio waves from space) being first developed in the 1950's.

Red Giant: A very large, distended, and relatively cool star which is in the final stages of its life. A typical

red giant, if placed where the Sun is in our solar system, might extend past the orbit of Mars. The relatively cool temperature of its outer layers (perhaps only 2,000 degrees Centigrade as compared to the Sun's 6,000 degrees) would make it look orange or red instead of yellowish-white. (The Sun is predicted to become a Red Giant about five billion years from now.)

Red Shift: The lengthening (or "stretching") of light waves coming from a source moving away from us. (If a source of light is moving toward us, the opposite effect — called a "Blue Shift" — takes place.) Light from all galaxies outside the Local Group is "red-shifted," indicating that they are moving away from us (and from each other). This phenomenon is called the "expansion of the Universe."

Second of Arc: A very small angle which is equal to 1/60th of a minute arc (which, in turn, is 1/60th of a degree). A line on the sky from horizon to horizon extends 180 degrees. A U.S. 10-cent piece seen from a distance of two miles has an apparent diameter of about a second of arc.

S.E.T.I.: An abbreviation for the "Search for Extra-Terrestrial Intelligence." (In the Soviet Union and some other places, this branch of astronomy has been called "C.E.T.I.," for "Communication with Extra-Terrestrial Intelligence.") At present, astronomers are undertaking this search by trying to find radio waves from space which may be artificial (i.e., intelligently coded).

Satellite: An object orbiting around another, larger one. For example, smaller bodies orbiting around planets are called those planets' "satellites" (or, occasionally, "Moons" — but some astronomers frown on this use of the word "Moon" since they feel it should be reserved for Earth's natural satellite exclusively.) Probes we launch into orbit around the Earth are called "artificial satellites."

Solar System: The Sun and all things orbiting around it, including the nine major planets, their satellites, and all the asteroids and comets.

Solstice: Either of the two instants during the year when the Sun as seen from Earth is farthest north or south of the equator. The Summer Solstice (when the Sun is over the Tropic of Cancer) occurs around June 21st; the Winter Solstice (when the Sun is over the Tropic of Capricorn) happens around December 21st. In the Northern Hemisphere, summer and winter officially begin at the instants of the Summer and Winter Solstices, respectively.

Spectroscopy: See "Spectrum."

Spectrum: The band of colors, from violet through red, obtained by passing white light through a prism (or another device that spreads light out into its component colors). Astronomical "spectroscopy," the study of the spectra of astronomical objects, is a very powerful tool in determining many characteristics of stars, nebulae, etc., since details of their spectra can reveal the materials they're made of and many of the physical conditions (temperature, pressure, and so on) within them.

Star: A large hot ball of gas which generates energy in its core by nuclear reactions. (The Sun is our local example of a star.)

Star Cluster: A group of stars which are held together by their mutual gravitational attraction. In the Milky Way, there are two different kinds of star of star clusters: ones called "open" (or "galactic") star clusters which are generally sparsely populated and exist only in the disk of the Galaxy, and the larger, older "Globular" clusters. (See "Globular Clusters.")

Sun: The star at the center of our solar system.

Supernova: An explosion which marks the end of a very massive star's life. When it occurs, the exploding star can outshine all of the other stars in the galaxy in total for several days and may leave behind only a crushed core (perhaps a neutron star or black hole). Astronomers estimate that a supernova explosion takes place about once a century in a galaxy like our Milky Way. While most supernovae in our Galaxy are probably hidden from our view by interstellar gas and dust, astronomers can detect supernova explosions in other galaxies relatively frequently.

Telescope: An instrument designed to gather light (or other kinds of radiation) from a large area and bring it to a focus, where the radiation can be analyzed. The primary purpose of most astronomical telescopes is to provide the brightest possible images, since most things that astronomers study are very faint. Thus, the "size" associated with a telescope (such as the "200-inch" on Palomar Mountain) refers to the diameter of its light-gathering area.

Universe: In astronomy, the sum total of all things which can be directly observed or whose physical effects on other things can be detected.

Variable Star: A star that changes its brightness. There are several classes of variable stars, including "periodic" variables (which change their brightnesses on a regular schedule, ranging from hours to many years) and "irregular" variables (which abide by no fixed schedule). Careful, long-term monitoring of variable stars is one major way in which amateur astronomers have made important contributions to research astronomy.

White Dwarf: The collapsed remnant of a relatively low-mass star (roughly one and a half times the Sun's mass and less), which has exhausted the fuel for its nuclear reactions and shines only by radiating away its stored-up heat. A typical white dwarf might have as much mass as the Sun, but have a size equivalent to the Earth's. Its density is roughly equivalent to that of a soda can into which a 747 airliner has been squeezed. (The Sun is expected to become a white dwarf at the end of its life.) ■